

Insular Haliotids in the Western Pacific

(Mollusca : Gastropoda)

BY

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(Plate 14)

References pertaining to the distribution and classification of the Sea Ears or Abalone (family Haliotidae) found on the islands of the far Western Pacific are widely scattered. The most recent monographic work on this family is that of Pilsbry (1890) in the Manual of Conchology. Since then, although there have been a number of interesting papers, chiefly local lists or descriptions of new species, no attempt seems to have been made to cover this region on a taxonomic or distributional basis. The present paper, therefore, may be of value to malacologists and biologists working on the marine fauna of this vast region.

GEOGRAPHICAL AREA COVERED

Abbott (1960) in his work on the genus *Strombus* discussed these islands and used the term "Pacific Arc". The distribution of the haliotids in this region appears to be similar in a number of aspects to that of the strombids from the Ryukyu Islands, near Japan, south and east through the Philippine and Indonesian archipelagos, to the islands and atolls of Melanesia, Micronesia, and southern Polynesia. This area constitutes a gigantic arc of islands covering most of the far Western Pacific Ocean. Certain species occur on the coasts of the major land areas of Australia, but here they appear to be only extensions of the range from the insular arc. We find series of endemic species in the Coral Sea and on the Barrier Reef of Australia, and two additional species, normally considered Australian, range into the Indone-

sian-Philippine Island area. Some questions have arisen as to the status of the far western major islands of Indonesia, Java, and Sumatra, but their marine fauna seems to place them well within the major area covered by this paper. Thus, the geographical scope of this paper is delineated.

FOSSIL RECORDS

The family Haliotidae is known from Japan, Australia, New Zealand, and California by fossil records, chiefly from the Miocene to the Recent. (There is also one Cretaceous record from California.) As far as could be determined on the basis of paleontological material available, there has been little change in the shell characteristics. The volcanic or high islands would be devoid of fossil specimens, except perhaps on relatively recent elevated shore terraces. It might be quite possible that some of the cores from the atolls or low islands would contain such specimens. Geological evidence now indicates that these sinking islands have been in existence since later Tertiary times, and as we know the family was well established over much of its present geographical range during the same period, it is quite probable that fossil data will turn up in due time.

METHODS AND MATERIAL

Certain named species were keyed out by the use of the soft parts as well as the shell. It had been found by Ino (1953) and Talmadge

(1957-58) that, although there is considerable variation in the shell due to age, ecological conditions, individual variations, and geographical distribution, the soft parts remained constant within a species. Thus, specimens that appear to belong to two distinct species actually could be only variations of a single widely distributed species. Identifications of many of these were verified by direct comparison with type material. Specimens were sent, for example, to the British Museum (Natural History) and compared with the original lots of Reeve, Sowerby, and others.

Major collections — museum, university, and private — were examined in an effort to determine the geographical races of various species, as well as their respective ranges. Many lots examined were simply labeled as "Japan", "Philippines", or "Pacific Islands"; these were disregarded for obvious reasons. Only lots with a collecting locality that could be plotted on a distributional map were utilized.

BIBLIOGRAPHY AND SYNONYMY

The bibliography listed for each species is far from complete. Works that would be available in most museum and university libraries are given preference. Certain publications are listed for historical reasons. One nonscientific publication that was available to the armed forces and is to be found in most small private libraries is listed.

Under each species I list the synonymy maintained in my collection. There probably will be some question as to the identification and status of some of these, and for this I assume full responsibility. Taxonomic classification is an artificial series of units set up by scientists for their convenience, and seldom do we find two taxonomists with identical opinions. Therefore, the never-ending question of classification will not be settled by this paper. Perhaps in time additional information may prove some or all of my interpretations to be in error.

Acknowledgment

I am grateful to the curators of several museum and university collections, both in the United States and abroad, for making the collections in their care available to me. Special

appreciation is expressed to Drs. Leo G. Hertlein, R. Tucker Abbott, J. P. B. Morrison, A. Myra Keen, Rudolf Stohler, and Takashi Iino, for discussing problems relating to this project. Mr. S. P. Dance of the British Museum (Natural History) generously devoted much of his time for direct comparison of specimens with the type material in its historical collections. There were a number of dealers who became interested in this project and went out of their way to obtain specimens with the soft parts preserved, together with accurate locality data. There were also a number of private collectors who did the same. Most of these wish to remain anonymous, so I can only express my general appreciation. Major collections will be listed at the end of this paper.

SPECIATION AND DISTRIBUTION

For convenience I will use a single genus, Haliotis, divided into rather broad subgenera. Some authorities consider these subgenera as of full generic rank. As there have been numerous names proposed and used from time to time, which would only confuse the distributional picture, I have referred only to those which pertained to a single species, referred to as being the type species.

Family: Haliotidae, Rafinesque, 1815

Genus: Haliotis Linnaeus, 1758

Type Species: Haliotis asinina Linnaeus, 1758, subsequent designation, Denys de Montfort, Conch. Syst. 2, p. 119, 1810, under L'Haliotide, Haliotis asininus, "Espèce servant de type au genre". Thus, this interesting, and actually non-typical species is the type species of the genus, and also of the subgenus s. s.

Subgenus: Haliotis s. s. Denys de Montfort

Haliotis (Haliotis) asinina Linnaeus

1758, Haliotis asinina Linnaeus, Syst. Nat. 10, #652.

1810, Haliotis asinina Denys de Montfort, Conch. Syst. 2, p. 119.

1854, Teinotis asinina H. & A. Adams, Gen. Rec. Moll. 1, p. 442.

Type in: Collection of the Linnaean Society of London (?).

Type Locality: As no type locality was given by Linnaeus or Denys de Montfort, and since no other worker seems to have designated a type locality as far as I have been able to ascertain,

and as Linnaeus used Rumphius as his primary source, I hereby designate Amboina, Indonesia, as the type locality. I cannot detect any difference in this species from any locality throughout its range.

Range: Ryukyu Islands (Okinawa); Philippines (all islands); Indonesia (Amboina, now Ambon; Java; Bali); New Guinea (Biak); Solomon Islands (Malaita); New Caledonia (Cook's Reef); Fiji (Suva); Loyalty Islands (Lifu); Mariana Islands (Guam); Caroline Islands (Palau). Records in the literature from Singapore and the China coast need confirmation. This species also ranges into Australian waters, being found at numerous stations along the Barrier Reef as well as in North Australia. Moreover, it is reported from Japan, but specimens from these areas are not included in the present study as the basic range appears to be the islands of the Pacific Arc.

Discussion: The soft parts of the animals are as unique as the shell. The latter forms a shield over the vital organs; the animal is much too large to ever be completely retracted beneath the shell, it being at least twice as long and twice as wide as the shell, as well as being rather deep. The upper portion of the epipodium can be curled over the edge of the shell, protecting the polished periostracum. According to field collectors, this species can control the spread of the epipodium in such a way that, as it plunges into the deeper tidal pools when disturbed, it simulates the gliding flight of the North American Flying Squirrels.

Subgenus: Padollus Denys de Montfort, 1810

Type Species: Haliotis parva Linnaeus. Original designation, Denys de Montfort, Conch. Syst. 2, p. 115, 1810. Denys de Montfort used the name Padollus rubicundus for the type of his genus Padollus. Röding, earlier, had used the same species name and had referred to a figure in Martini which was the orange phase of H. parva Linnaeus. De Montfort's use of the same name, as well as the same locality, together with Iredale's work (1911) on this subject, is a very strong indication that the Linnaean species may be considered the type of the genus. Type species, Padollus rubicundus Denys de Montfort = Haliotis parva Linnaeus. Type locality: "Côtes d'Afrique".

There have been a number of names proposed, either generic or subgeneric, for species of this general form of shell. However, I consider these to be only good species, not war-

ranting higher taxonomic separation. By the use of the conservative approach, all are placed in a single subgenus in this paper.

Haliotis (Padollus) pulcherrima Gmelin, 1791
1791, Haliotis pulcherrima Gmelin, Syst. Nat. 13, #3640.

1846, Haliotis pulcherrima, Reeve, Conch. Icon. 3, Sp. 1, Pl. 1, fig. 1.

1890, Haliotis pulcherrima, Pilsbry, Man. Conch. 12, p. 124, Pl. 13, fig. 69.

1959, Haliotis pulcherrima, Webb, Handbook for Shell Collectors, pp. 128-129, fig. 13.

Type in: ? — Lost?

Type Locality: Presumed to be one of the Gambier Islands "Lord Hood".

Range: Endemic to the Tuamotu Archipelago (Paumotu): Raraka, Raroia; Gambier Islands. I have seen specimens with the label Samoa, but this locality needs verification. There are also Australian records referring to King George Sound (which one?), and these also need definite confirmation.

Discussion: This ornately sculptured and colored shell needs little comment. There is no other small, circular haliotid in the Western Pacific with such sculpturing so that it need never be confused with any other species.

Haliotis (Padollus) dohrniana Dunker, 1882
1882, Haliotis dohrniana Dunker, Novit. Conch., p. 48, Pl. 15, figs. 13-15.

1890, Haliotis dohrniana, Pilsbry, Man. Conch. 12, p. 98, Pl. 7, figs. 38, 40, 41 (see Plate 14, Figure 7).

Type in: ?

Type Locality: New Hebrides Islands (Dunker, Pilsbry).

Range: Except for the type locality, cited by Pilsbry who copied the original figures of Dunker, the only data that I have are based upon three specimens. These are: 1) California Academy of Sciences, San Francisco, locality "New Hebrides"; 2) Bogor Museum, Bogor, Java, labeled only "Dutch East Indies"; and 3) Talmadge Collection, labeled "Formosa".

Discussion: I have not seen the soft parts of this little-known species, nor do I have any additional information on it. Specimens labeled with this name have been received from time to time, but in all cases they have proved to be Haliotis planata Sowerby. Based upon the three

specimens examined, I place the species in the subgenus Padollus, although there are a number of features that do not agree with this general classification. What the exact taxonomic status is remains a question until the soft parts of the animal and larger sets of shells are available for study.

Haliotis (Padollus) ovina Gmelin, 1791

1791, Haliotis ovina Gmelin, Syst. Nat. Ed. 13, #3671.

1846, Haliotis ovina, Reeve, Conch. Icon, 3, Sp. 28, Pl. 9, fig. 28.

1890, Haliotis ovina, Pilsbry, Man. Conch. 12, p. 124, Pl. 19, figs. 7-8.

1943, Ovinotis ovina, Cotton, Trans. Roy. Soc. So. Aust. 67, p. 179.

1959, Haliotis ovina, Webb, Handbook for Shell Collectors, p. 105, fig. 2.

Type in: ? — Lost?

Type Locality: Philippines (Cotton).

Range: Ryukyu Islands (Okinawa); Philippine Islands (Luzon; Samar; Cebu); Dutch New Guinea (Schouten Island); Solomon Islands (Malaita); New Caledonia (Cook's Reef); Loyalty Islands (Lifu); Fiji Islands (Suva); Indonesia (Java, Ambon); Caroline Islands (Palau); Mariana Islands (Guam). Specimens have been examined from southern Japan and the Barrier Reef off the east coast of Australia. There are also records from Malaya and the coast of China, but these appear to be extensions of the basic insular range.

Discussion: Except for individual variations in color, this species is uniform over the known range. Cotton (1943) used the species as the type of the genus Ovinotis. As I consider a genus or a subgenus as a rather broad group of species with similar features, it is difficult to accept the additional taxon, based upon what I

consider to be minor features, as in the best interest of general knowledge. It is true that we have a number of strong species and a great number of weak or poorly defined species. However, when we take the family Haliotidae as a whole, and include the comparison of the soft parts, these additional generic units seem not to be appropriate.

Haliotis (Padollus) ruber clathrata Reeve, 1815

1815, Haliotis ruber Leach (partim) Zool. Misc. T. 54, fig. 23.

1846, Haliotis clathrata Reeve, Conch. Icon. 3, Sp. 71, Pl. 17, fig. 71.

1890, Haliotis clathrata, Pilsbry, Man. Conch. 12, p. 116.

1957, Haliotis ruber clathrata, Talmadge, Nautilus, 71 (2), p. 59.

Type in: British Museum (Natural History).

Type Locality: Bohol, Philippines (Reeve).

Range: Indonesia (Bali); Malaya (Singapore); New Guinea (Trobriand Islands); New Caledonia (Cook's Reef); Marshall Islands (Eniwetok); Eastern Caroline Islands (Palau); Phoenix Group (Canton Island); Philippine Islands (Bohol); Australia (Thursday Island; Great Barrier Reef off Cooktown and Townsville).

Discussion: For many years this race was thought to be the juveniles of Haliotis ruber; some authors considered it as a distinct species. However, due to the fact that the shells of H. ruber are consistently smaller and depressed, more rounded and with a stronger suture between the siphonal angle and the left edge, as specimens were obtained from more northern stations along the Barrier Reef, it began to be suspected that we are dealing with a single species rather than two. Comparison of soft parts supports this assumption.

Explanation of Plate 14

- Figure 1: Haliotis (Sanhaliotis) crebrisculpta SOWERBY, 1914 (variety). North Keppel Island, off Yeppoon, Queensland, Australia. Figure 2: Haliotis (Sanhaliotis) planata SOWERBY, 1883. Okinawa, Ryukyu Islands. Figure 3: Haliotis (Sanhaliotis) exigua DUNKER, 1877. Okinawa, Ryukyu Islands (topotype?). Figure 4: Haliotis (Sanhaliotis) howensis (IREDALE, 1929). Lord Howe Island, off New South Wales, Australia (topotype). Figure 5: Haliotis (Sanhaliotis) varia stomataeformis REEVE, 1846. North Coast of Java, Indonesia (topotype). Figure 6: Haliotis (Schismotis) glabra GMELIN, 1791. Zamboanga, Philippine Islands. Figure 7: Haliotis (Padollus?) dohrniana DUNKER, 1882. Formosa? Figure 8: Haliotis (Sanhaliotis) jacnensis REEVE, 1846. Okinawa, Ryukyu Islands. Figure 9: Haliotis (Sanhaliotis) hanleyi ANCEY, 1881. Ile Nou, New Caledonia (topotype).

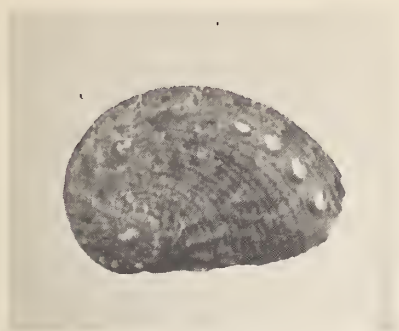


Figure 1

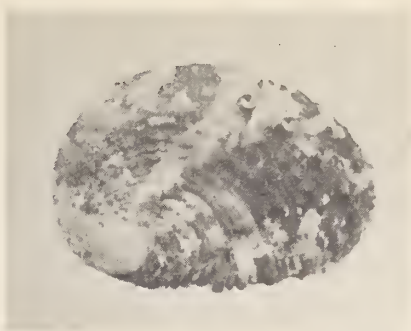


Figure 2

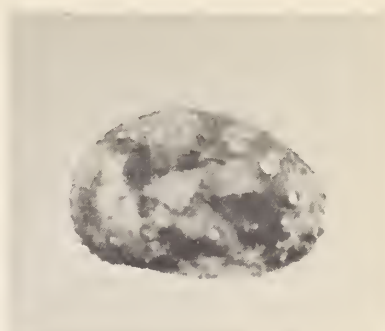


Figure 3

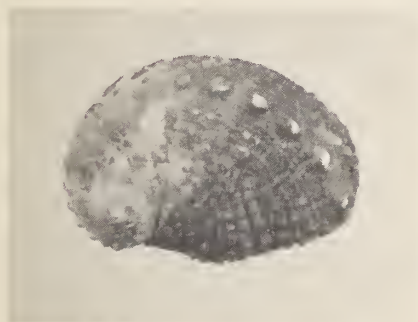


Figure 4



Figure 5

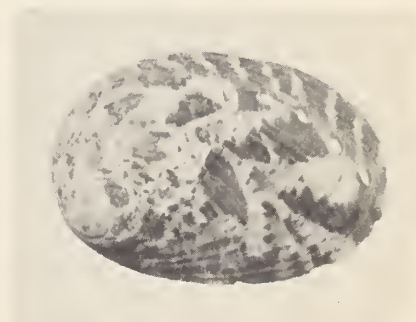


Figure 6

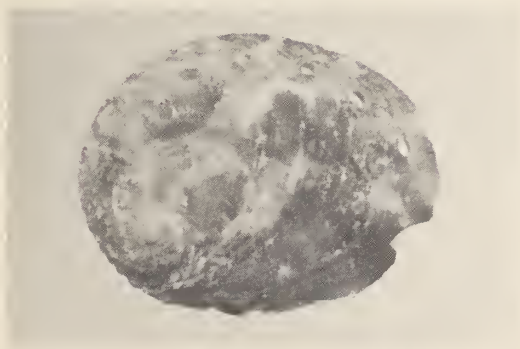


Figure 7

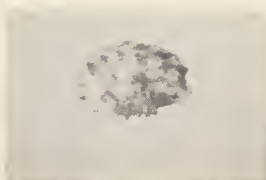


Figure 8



Figure 9

Here we have an example of a cooler water species extending its range into tropical waters and also adapting itself to a new ecological biome, that is, changing from a rocky substratum to coral. It is not surprising that the earlier malacologists considered this to be a distinct species or a juvenile. It is extremely difficult to separate many of the juvenile specimens of the typical *Haliotis ruber* from this northern, tropical race.

Subgenus: *Schismotis* Gray, 1856

Type Species: By monotypic description, *Haliotis excisa* Gray, 1856, Proc. Zool. Soc. London, pt. 24, p. 148 (a pathological example, or perhaps the localized cline from Geraldton, West Australia) = *Haliotis laevigata* Donovan, 1808 = *Haliotis albicans* Quoy & Gaimard, 1834.

There are three known species of haliotids having great similarities that I place in this subgenus, one of which falls within the scope of this paper. All are noted for the larger number of open siphonal pores, the rim of the pores not being elevated, and the smooth dorsal surface of the shell usually with little attached growth. At times the cording found in juvenile shells is continued into the adult stage.

Haliotis (*Schismotis*) *glabra* Gmelin, 1791
1791, *Haliotis glabra* Gmelin, Syst. Nat. 13, #3690.

1846, *Haliotis glabra*, Reeve, Conch. Icon. 3, Sp. 2, Pl. 1, fig. 2.

1846, *Haliotis ziczac* Reeve, Conch. Icon. 3, Sp. 24, Pl. 8, fig. 24.

1959, *Haliotis glabra*, Webb, Handbook for Shell Collectors, pp. 104-105, fig. 5 (see Plate 14, Figure 6).

Type in: ? — Lost?

Type of Reeve's *Haliotis ziczac*: British Museum (Natural History).

Type Locality: ? *Haliotis ziczac* Reeve, Calapan, Philippines (Reeve). Type locality of the nominate form probably is also Philippines.

Range: Apparently only from the Philippine Islands (Luzon; Cebu; Samar; Bohol; Mindoro). There are two specimens labeled "North Borneo" in the collection of the Bogor Museum which are this species. The locality needs verification but is probably correct. Australian specimens labeled *Haliotis glabra* have all turned out to be the green phase of *H. varia*

Linnaeus; the misidentification* was probably caused by a figure in Webb (p. 214, fig. 3) which, although labeled *H. glabra*, is actually *H. varia*.

Discussion: Certain examples of this smooth flat species retain the juvenile cording into adult stages, and these were the bases for Reeve's *Haliotis ziczac*. The coloration is usually referred to as green and cream, with triangular or tent-like markings. Series of shells show that the shell may be concolored or maculated, green, brown, tan, cream, or even pink in any combination.

Subgenus: *Sanhaliotis* Iredale, 1929

Type Species: By original description, *Haliotis varia* Linnaeus, Iredale, Mem. Queensland Museum, 9(3), p. 270.

Haliotis (*Sanhaliotis*) *varia* Linnaeus, 1758

There has been considerable confusion regarding this highly variable species. Reeve (1846) named, described, and figured as full species a number of color phases, age stages, individual variations, as well as geographical races. Interpretations of these by authors, shell dealers, and collectors, without comparison with the type material, further compounded the confusion. By working with uncleaned, unsorted series which contained the animal parts, I think I now have an understanding of the basic identification and distribution. Selected specimens from various lots were compared with the original material to confirm many of the identifications.

I presently recognize three geographical races or subspecies. Two of these fall within the scope of this study. It has been found that the three races freely interbreed and intergrade at the points of contact. Actually, there is no sharp line separating the races. Rather, we find a gradual transition of features over an extensive area.

Haliotis (*Sanhaliotis*) *varia varia* Linnaeus, 1758
1758, *Haliotis varia* Linnaeus, Syst. Nat. Ed. 10, #650.

1766, *Haliotis varia* Linnaeus, Syst. Nat. Ed. 12, #1256.

1846, *Haliotis varia*, Reeve, Conch. Icon. 3, Sp. 4, Pl. 2, fig. 4.

1846, *Haliotis concinna* Reeve, Conch. Icon. 3, Sp. 66, Pl. 17, fig. 66.

1846, *Haliotis semistriata* Reeve, Conch. Icon. 3, Sp. 51, Pl. 15, fig. 51.

1846, *Haliotis viridis* Reeve, Conch. Icon. 3, Sp. 40, Pl. 13, fig. 40.

1855, *Haliotis varia*, Hanley, Ipsa Linnaei Conch., p. 411.

1890, *Haliotis varia* var. *pustulifera* Pilsbry, Man. Conch. 12, p. 96, Pl. 17, fig. 91.

1929, *Sanhaliotis varia* Iredale, Mem. Queensland Mus. 9(3), p. 270.

1956, *Haliotis varia*, Talmadge, Min. Conch. Club So. Calif., 161, pp. 3-7.

Type in: Collection of the Linnaean Society of London (?).

Type: Syst. Nat. 12, Museum Ulricae, Sweden. (Microfilm of type specimens at the Smithsonian Institution, Washington, D. C.)

Type Locality: Philippines, so designated by Reeve, Iredale, and others.

Range: Ryukyu Islands (Okinawa); Philippines (Bataan; north and east coasts of Luzon; east coast of Samar; Leyte; Davao; Cebu*; Zamboanga*); Mariana Islands (Guam); Caroline Islands (Palau); Marshall Islands (Kwajalein); Dutch New Guinea (Schouten and Trobriand Islands); Solomon Islands (Bougainville; Malaita); Papua (Port Moresby*); Loyalty Islands (Lifu); Fiji (Suva); Friendly Islands. (* indicates series of shells which, although they fit into the nominate race, show indications of intergrading with adjacent populations.)

Discussion: The basic race of *Haliotis varia* s. s. is ovate, small to medium sized, and is highly sculptured with nodes, lamellae, and tubercles. The siphonal pores are moderately elevated crater-like projections, and the spire is somewhat elevated. The color varies; some specimens are concolored, others are rayed, striped, or maculated, in black, green, brown, red, cream, white, or even yellow. There are almost as many color combinations as well as sculpturing combinations as there are individual specimens. Juvenile shells lack the strong sculpturing and are more ovate and depressed.

When plotted on a map the collecting localities turn out to be situated on coasts adjacent to major bodies of deep water. The deep water probably has a tempering effect upon the surface temperatures, which may, in turn, have a definite effect upon the shape and sculpturing of the shell of the nominate race.

The majority of the names proposed by Reeve (1846) apply to color phases only, which

may be found in any of the three geographical races. Several other names used by Reeve pertain to distinct color and sculpturing, which seem more or less restricted to Australian waters, not covered in this paper.

Haliotis viridis Reeve is actually a green or green-and-cream colored form of any race of *H. varia*. *Haliotis concinna* Reeve may be either red or red-and-white maculated. *Haliotis semistriata* Reeve has an unusual stripe, and some individuals are black and white, while others are brown and white, as figured by Reeve. A yellow-and-red rayed form was used by Reeve as the basis for his *H. papulata*, but other details not covered in this paper indicate that the last-mentioned name is under the rules of priority the proper name to be used for the mainland Australian race. However, the color form of red and yellow is found in all three geographical races. The rayed color form of *H. varia* as figured by Reeve has been considered by Pilsbry as representing the typical species. Hanley (1855) referred to the actual type specimen in the collection of the Linnaean Society of London as being the same as figured by Martini (1790, fig. 144). This is a maculated nodose specimen. The microfilm photograph at the Smithsonian Institution of the type material from the Linnaean Collection in the Museum Ulricae in Sweden also shows a maculated nodose specimen, similar to the figure cited above in Martini. Pilsbry's var. *pustulifera* is similar, is nodose and maculated, but due to the fine markings, the shell appears uniform. The two types of Pilsbry's variety are in the Academy of Natural Sciences of Philadelphia (Nos. 50179 and 210843, and not from the same locality). Most of Reeve's types are in the British Museum (Natural History).

Haliotis (Sanhaliotis) varia stomatiaeformis
Reeve, 1846

1846, *Haliotis stomatiaeformis* Reeve, Conch. Icon. 3, Sp. 73, Pl. 17, fig. 74.

1890, *Haliotis stomatiaeformis*, Pilsbry, Man. Conch. 12, p. 89, Pl. 3, fig. 4.

1956, *Haliotis varia*, Talmadge, Min. Conch. Club So. Calif., 161, pp. 3-7 (see Plate 14, Figure 5).

Type in: British Museum (Natural History).

Type Locality: "Hab. New Zealand" (Reeve). This is obviously an error, as no haliotids of this type have been found in New Zealand waters

as far as I know. A specimen from a set of shells, taken on the north coast of Java, was compared with the type specimen and found to be the same species. Series from the shallow Indonesian seas are fairly uniform and quite similar, except for color. Therefore, I consider it proper to designate a new type locality for *Haliotis varia stomatiaeformis* Reeve: North Coast of Java, Indonesia.

Range: Indonesia (North Coast of Java; Ambonina; Bali); New Caledonia (Cook's Reef); Australia (Darwin; Thursday Island*); Swain's Reef, Coral Sea off Queensland, Australia. (* indicates populations with specimens appearing to intergrade with adjacent populations.)

Discussion: As mentioned under *Haliotis varia s. s.*, certain localities had populations that showed a mixing or merging of populations. The southern and interior Philippine stations are inhabited by a mixed population, exhibiting some specimens more closely allied to the Indonesian race, others more closely related to *H. varia s. s.* The two northern Australian stations have a similar mixed population, some of the specimens exhibiting characteristics which are Indonesian, others in the same series with definite Australian characteristics.

The typical *Haliotis varia stomatiaeformis* is a smaller, more elongate, deeper, and smoother shell than the nominate race. It is sculptured with cording only, the nodes and tubercles of the more northern race are lacking, yet the animals are identical in all other features. There is some variation in the strength of the cording but usually only in localized clines. The specimens from Cook's and Swain's Reefs pose a question regarding distribution. Are there two separate areas of distribution for this race, or does the race radiate out of the Torres Strait into the Coral Sea? Specimen material has not been located from other, particularly intermediate, stations between these two separate areas. This is a question that must await further collecting, as at the present time there is no indication of two sibling species, although we seem to have a population isolated from the basic range of the geographical race.

Haliotis (Sanhaliotis) planata Sowerby, 1833
1883, *Haliotis planata* Sowerby, Thes. Conch. 5, p. 30, fig. 74.
1890, *Haliotis planata*, Pilsbry, Man. Conch. 12, p. 99, Pl. 11, fig. 58, Pl. 49, figs. 20-22 (see Plate 14, Figure 2).

Type in: ? — Lost?

Type Locality: ? This species appears to have been confused by many authors with *Haliotis varia* Linnaeus, which in turn has confused the taxonomic and distributional picture. I was unable to locate any definite designation of a type locality. Therefore, as this species appears to be relatively common in the Ryukyu Islands, I hereby designate Okinawa, Ryukyu Islands, as the type locality.

Range: Ryukyu Islands (Okinawa); Philippines (North Coast of Luzon); Solomon Islands (Malaita); Fiji (Suva)?; Indonesia (South Coast of Java = Wynkoops Bay).

Discussion: This flat coral-dwelling species has often been confused with the more common *Haliotis varia* Linnaeus. The shell is more ovate, the sculpturing more sharply cut, cording stronger, with small sharp nodes. The spire is always depressed, giving the appearance of a small flat, disc-like rough haliotid. Juveniles are extremely difficult to separate, but unlike *H. varia*, the young of *H. planata* are somewhat elongate rather than round. Some authors have considered this species to be only a race of *H. varia*, but the more ornate processing of the epipodium as well as shell features do not bear out this concept.

Haliotis (Sanhaliotis) hanleyi Ancey, 1881
1881, *Haliotis hanleyi* Ancey, Le Nat. 3(52), p. 415.
1890, *Haliotis hanleyi*, Pilsbry, Man. Conch. 12, Supp. p. 291.
1929, *Haliotis hanleyi*, Iredale, Mem. Queensland Mus. 9(3), Pl. 31, fig. 1 (type) (see Plate 14, Figure 9).

Type in: Australian Museum (Iredale).

Type Locality: Île Nou, New Caledonia.

Range: Known only from around Noumea, New Caledonia, possibly only from the type locality.

Discussion: This is another uncommon species. Only three lots are known to me: a series in the San Diego Natural History Museum, a set of three in the American Museum of Natural History, and a set of two in my own collection. Field data indicate that this species inhabits rocks rather than coral and is endemic to the west coast of New Caledonia. It is a small species, 15 to 20 mm long, and is usually more rounded than *Haliotis jacnensis* Reeve, with which it may be confused. Two features that are probably consistent, which will separate the

two closely allied species, are that in H. hanleyi the right or growing edge of the shell is more smooth, and that the cording in H. hanleyi is very coarse, with a more depressed spire than in H. jacnensis.

Haliotis (Sanhaliotis) exigua Dunker, 1877
1877, Haliotis exigua Dunker, Mal. Blät., p. 69.
1882, Haliotis exigua Dunker, Index Moll. Japan (Novit. Conch.), p. 149, Pl. 6, figs. 8-10.
1890, Haliotis exigua, Pilsbry, Man. Conch. 12, p. 90, Pl. 49, figs. 36-38 (see Plate 14, Figure 3).

Type in: ?

Type Locality: "Japanese Seas" (Dunker).

Range: Known to me only from the Ryukyu Islands (Okinawa).

Discussion: There are two specimens in my collection, both taken from coral crevices on the China Sea Coast of Okinawa. One is scarlet with a few small white maculations, and the other is a pale green with large brown maculations. The original description called for a shell that was chiefly yellow or yellowish. However, I do not know if Dunker's figured shell was taken alive. The lighter colored specimen of my two was a beach shell. Specimens of this may turn up in private collections labeled Haliotis varia Linnaeus, but the shell can be distinguished by being much thinner, smoother, the apex and spire strongly elevated, with the major or bodywhorl rather flat. Dr. Takashi Ino (personal communication) mentions that the species has been recognized by Japanese malacologists and is considered rare in some of the lesser Japanese Islands off the coast of Southern Japan. It is evidently one of the rare species, and little seems to be known other than the original description and figure. The epipodium of the one animal examined was rather smooth, unlike either H. planata or H. varia, which are rather strongly processed.

Haliotis (Sanhaliotis) jacnensis Reeve, 1846
1846, Haliotis jacnensis Reeve, Conch. Icon. 3, Sp. 72, Pl. 17, fig. 73.
1883, Haliotis echinata Sowerby, Thes. Conch. 5, p. 18, fig. 124.
1890, Haliotis echinata, Pilsbry, Man. Conch. 12, p. 89, Pl. 3, fig. 7 (see Plate 14, Figure 8).

Type in: British Museum (Natural History) ? (uncertain).

Type Locality: Jacna, Bohol, Philippines (Reeve).

Range: Ryukyu Islands (Okinawa); Philippines (Luzon; Bohol; Cebu); Mariana Islands (Guam); Caroline Islands (Palau; Truk; Ponape); Marshall Islands (Eniwetok; Bikini; Rongelap; Kwajalein — almost all islands represented); Fiji (Suva); Loyalty Islands (Lifu); New Hebrides (Espíritu Santo); Bismarck Archipelago (Rabaul).

Discussion: This is probably the smallest species of the family, as few examples reach over 20 mm in length. The average runs from 12 to 15 mm long. As certain animals pass into a more or less senile stage, the shell becomes more coarsely corded and rounded, altering into a form which furnished the basis for Sowerby's Haliotis echinata. Such examples are not restricted to any special region within the range of this species. This is a coral-dwelling species, and even on the high islands they are found only on the outer edge of the fringing reef, and on such islands they are not common. They seem to prefer atolls, judging from the large series that were available for study at the Smithsonian Institution. Discussions with Dr. J. P. E. Morrison and the detailed maps available at that museum revealed to me the preference for the coral atolls by this species.

Haliotis (Sanhaliotis) howensis (Iredale, 1929)
1929, Sanhaliotis howensis Iredale, Mem. Queensland Mus. 9(3), p. 270 (see Plate 14, Figure 4).

Type in: Australian Museum (Iredale).

Type Locality: Lord Howe Island, off the coast of New South Wales, Australia (Iredale).

Range: Endemic to the type locality as far as known.

Discussion: Although this island is not in the true sense in the Pacific Arc, it seems to be closely related by the molluscan fauna, especially the primitive species, to the New Caledonia-Coral Sea area. As far as I know, the only material of this species in the United States is in my collection. The shell is deep, elongate, coarsely corded, small, and relatively thick. The cording under a strong magnifying glass resembles the rounded overlapping terra cotta tiles of the Spanish-Californian roofs. The animal is unknown to me. I do not think that the species has been figured.

Haliotis (Sanhaliotis) squamata Reeve, 1846
1846, Haliotis squamata Reeve, Conch. Icon. 3, Sp. 35, Pl. 13, fig. 35.

1883, Haliotis elevata Sowerby, Thes. Conch. 5, p. 27, figs. 116-117.

1890, Haliotis squamata, Pilsbry, Man. Conch. 12, p. 91, Pl. 18, fig. 2.

1890, Haliotis elevata, Pilsbry, Man. Conch. 12, p. 90, Pl. 14, figs. 14-15.

Type in: British Museum (Natural History).

Type Locality: "Northwest Coast of Australia: Dring" (Reeve).

Range: West and Northwest Coast of Australia. Extension into the area covered by this paper: Indonesia (Sunda Straits; Prinz Eiland = P. Paraitan; South Coast of Java = Wynkoops Bay).

Discussion: On the Australian coasts this species exhibits a number of color forms and patterns. In contrast, all of the specimens examined from Indonesian waters were maculated in intense green, brown, and white. Juvenile specimens from the coral of Indonesia are more elongate and retain the lamellae until larger in size, as compared to Australia examples. An extremely elongate shell with strong lamellae is the basis for Haliotis elevata Sowerby, actually more or less of a pathological specimen; this aberrant form has been found a few times.

Haliotis (Sanhaliotis) crebrisculpta Sowerby, 1914

1914, Haliotis crebrisculpta Sowerby, Ann. Mag. Nat. Hist. Der. 8, 14, p. 478.

1929, Sanhaliotis crebrisculpta, Iredale, Mem. Queensland Mus. 9(3).

1961, Haliotis crebrisculpta [sic.], Talmadge, The Veliger, 3(4), p. 113 (see Plate 14, Figure 1).

Type in: British Museum (Natural History).

Type Locality: New Caledonia (Sowerby).

Range: Based upon the few specimens available, the range appears to be divided into two widely separated areas. There is one exception which will be noted. The range appears to be the Coral Sea coasts of New Caledonia and Australia, and the Hachijo Jima group north of the Izu Shichito off Southern Japan. The one isolated locality is based upon a specimen from Singapore in the collection of the Academy of Natural Sciences of Philadelphia.

Discussion: Several interesting factors enter into the distribution of this species. Eight specimens of the nominate race were examined, and all were similar. There is also a slightly

different population on the islands off the coast of Queensland. Iredale (1929) referred to this species as being found on Michaelmas Island, off Cairns, Queensland, and it may be questioned whether he had the actual Haliotis crebrisculpta s.s. or, instead, the Australian race, which is very similar. Swain's Reef, well offshore from the Queensland Coast, supports an intermediate population. The Singapore specimen presents a problem, as there is no similar species in the Bogor Museum Collection, nor had Dr. Tweedie (personal communication) of the Raffles Museum ever mentioned this species. As far as known, there are no specimen-based records in the area between New Caledonia and the Coral Sea coasts, and the small offshore islands in the north, just south of Japan, with this one notable exception.

Certain species of the genus Strombus, according to Abbott (1960), have similar divided ranges. The hypothesis has been advanced by Abbott that these isolated similar or identical species are relics of a past distribution that has been destroyed or separated by geological forces. The broken distribution of Haliotis crebrisculpta appears to support this theory. Further support and interest is added by the description and figure of a late Cenozoic haliotid from New Zealand, H. powelli Fleming (1952). Although Fleming places this in the revised subgenus Sulculus of H. & A. Adams, 1854, there are many features that would agree with the Recent H. crebrisculpta and H. howensis. It would not be difficult to associate the Australian H. coccoradiata Reeve with this same type of shell. It is possible that there have been a number of broader distributions in the geological past, which have been broken by physical barriers. These in turn could easily have been further divided by other natural events that may have destroyed the populations within certain portions of the race. The similarity of the Japanese and New Caledonian examples of H. crebrisculpta could possibly be explained as relic populations; the intermediate and continuous range of the past may have been destroyed by the volcanic activity of the Indonesian-Philippine region.

Discussion

Most malacologists have attributed the source of the many species in the family Haliotidae to what is generally termed the Indo-Pacific Area. However, closer examination in